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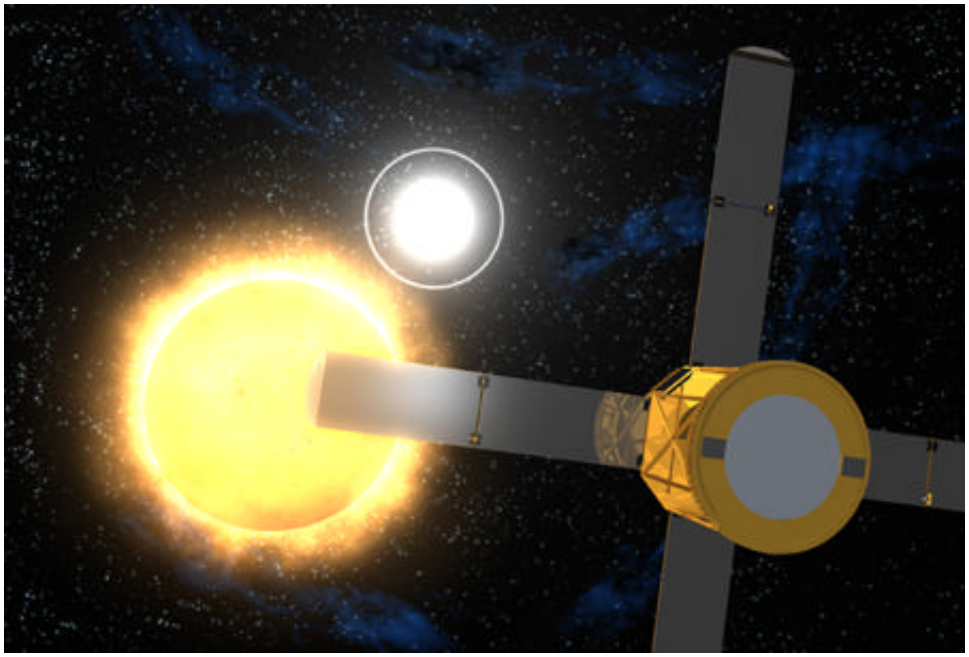
Magnetism Powers Gamma Ray Bursts

NASHVILLE, TENNESSEE--A solar satellite has cracked one of the biggest mysteries of gamma ray bursts (GRBs), the brightest explosions in the universe. The satellite spied highly organized radiation streaming from the heart of a recent burst, a sure sign that intense magnetic fields control the energy spewing into space. Indeed, the study--described here 28 May at a meeting of the American Astronomical Society--suggests that jets from the bursts consist almost entirely of radiation rather than fast-moving matter, as most theorists have assumed.



Solar stare. While monitoring the sun, this x-ray satellite--shown in an artist's conception--spied gamma rays from a distant burst.
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Astrophysicists think GRBs arise when the cores of giant stars suddenly collapse into spinning black holes. According to computer models, a thick torus of whirling gas plunges into the black hole in about 10 seconds. At the same time, jets blast out of

the top and bottom of the torus. If a jet points toward Earth, astronomers see a blast of gamma rays. These models have not included strong magnetic fields, which are difficult to simulate. However, no observations had shown that magnetic fields played a major role.

That changed on 6 December 2002, when a burst popped off close to the sun's position in the sky. No telescopes on Earth could watch the event. However, its gamma rays triggered nearly 100,000 electronic blips in the detectors of the Ramaty High-Energy Solar Spectroscopic Imager (RHESSI), a NASA solar satellite. Some gamma rays scattered from one of RHESSI's nine detectors into an adjacent one. By tracing the patterns of this scattering, the RHESSI team found that the gamma rays were extremely polarized, or aligned with their electric fields in a preferred direction. The only explanation is that powerful magnetic fields--perhaps stronger than any seen elsewhere in the universe--ordered the burst's energy. Without such fields, the gamma rays would have sprayed into space with random orientations, says physicist Steven Boggs of the University of California, Berkeley. Boggs and RHESSI colleague Wayne Coburn also reported their findings in the 22 May issue of *Nature*.

"This is absolutely an astounding result," says astrophysicist Donald Lamb of the University of Chicago. "It's a slam dunk that magnetic fields are dominant." Lamb suspects that a jet of charged particles ejected from the region near the black hole could not stay organized enough to produce such strong alignment. Rather, he says, most energy from GRBs may consist of electromagnetic radiation. His own analysis of dozens of bursts, not yet submitted for publication, suggests that magnetic fields confine the jets to needlelike cones just 0.5 angular degrees wide--far narrower than theorists have thought.

--ROBERT IRION

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